probability of success in that year was significantly lower than that of men (column (ii)). Quit attempt rates for both sexes (column (i)) declined by 1975, but have increased in 1978 to 1979. With respect to the probability of attempting to quit and the success rate, adult men and women cigarette smokers are now indistinguishable.

Table 3 displays recent changes in the distribution of cigarette brands according to F.T.C. "tar" contents. The proportion of adults smoking cigarettes with F.T.C. "tar" delivery less than 15 milligrams has increased from 9.5 percent of women and 2.9 percent of men in 1970 to 38.5 percent of women and 28.1 percent of me in the first half of 1979. A corresponding increase in the proportion of smokers of cigarettes with F.T.C. nicotine delivery less than 1.0 milligram was also observed.

**TABLE 3.—Estimated percentage distribution of adult current regular cigarette smokers according to F.T.C. "tar" content of primary brand, United States 1970–1979**

| Year | Less Than 5.0 mg | 5.0 to 9.9 mg | 10.0 to 14.9 mg | 15.0 to 19.9 mg | 20.0 mg or More |
|---|---|---|---|---|---|
| Women | | | | | |
| 1970 | 0.7 | 2.0 | 6.8 | 67.1 | 23.4 |
| 1975 | 1.2 | 1.2 | 15.0 | 75.1 | 7.5 |
| 1978 | 5.3 | 8.8 | 21.1 | 59.2 | 5.7 |
| 1979 | 5.6 | 9.5 | 23.4 | 55.4 | 6.1 |
| Men | | | | | |
| 1970 | 0.2 | 0.9 | 1.8 | 61.3 | 28.1 |
| 1975 | 0.6 | 1.1 | 11.0 | 68.1 | 19.2 |
| 1978 | 3.3 | 6.2 | 13.5 | 63.5 | 13.6 |
| 1979 | 2.6 | 8.5 | 17.0 | 60.1 | 11.8 |

1979 data are preliminary estimates provided by the National Center for Health Statistics. 1970 and 1975 data represent adults aged 21 years and over. 1978 and 1979 data represent adults aged 17 years and over. Estimates exclude those with unknown primary cigarette brand.
SOURCE: U.S. Department of Health, Education, and Welfare (54,61,62).

At the same time, the average daily cigarette consumption of adult smokers has increased. Table 4 shows recent changes in the distribution of reported daily cigarette consumption among current smokers. These data must be interpreted in light of possible underreporting biases (65) and, in particular, a strong tendency for respondents to round off their reported daily consumption to one pack. Nevertheless, the percent of women smoking less than one pack per day has declined, while the proportion smoking more than one pack per day has increased. Except for 1979, a similar trend is observed for men. (The absolute

standard errors of the 1978 and 1979 estimates are approximately 1.0 percent.)

The data of Table 4 represent the more recent portion of an apparently long run trend toward increasing daily cigarette consumption among regular smokers. In 1924, Milwaukee men smokers consumed an average of 10 cigarettes per day (38). In 1934, male smokers in Milwaukee consumed an average of 13.4 cigarettes per day, while women smokers consumed 7 per day (38). If cigarette consumption in 1935 was 1,564 per adult (Figure 1 and (50)), and if the overall percentage of adult smokers was 37.3 percent (12), then mean consumption per adult smoker was 11.5 cigarettes per day. If consumption per adult was 3,597 in 1955 and if the prevalence of regular smoking was 37.6 percent (16), then mean consumption per adult in that year was 26.2 cigarettes. The corresponding calculation based on 1979 per capita consumption data and adult prevalence data (Figure 1 and Table 1) yields 33.3 cigarettes per day.

Numerous epidemiological studies and other surveys performed during the period 1950 to 1965 have shown that for both

**TABLE 4.—Estimated percentage distribution of adult current cigarette smokers according to reported daily consumption frequency, United States, 1965–1979**

| Year | Percent Smoking Less Than 15 Cigarettes per Day | Percent Smoking 25 Cigarettes or More per Day |
|---|---|---|
| Women | | |
| 1965 | 44.5 | 13.7 |
| 1970 | 39.1 | 18.0 |
| 1974 | 38.7 | 18.5 |
| 1976 | 36.5 | 19.6 |
| 1978 | 36.0 | 21.0 |
| 1979 | 34.6 | 22.4 |
| Men | | |
| 1965 | 29.6 | 24.5 |
| 1970 | 27.8 | 27.7 |
| 1974 | 26.3 | 30.6 |
| 1976 | 24.2 | 31.1 |
| 1978 | 23.4 | 34.2 |
| 1979 | 26.4 | 32.2 |

Data for 1976 represent persons aged 20 years and over. All other years represent persons aged 17 years and over. Data for 1979 are preliminary estimates based on interviews conducted during January–June of that year, provided by the Health Interview Survey, National Center for Health Statistics.

SOURCE: Harris, J. E. (26), U.S. Department of Health, Education, and Welfare (54–56,58–59).

sexes, especially for women, the proportion of heavy smokers was larger among the younger age groups (14,16,19,20,22, 30,36,61,64). These findings applied to current daily cigarette consumption and lifetime maximum cigarette consumption. They are consistent with the hypothesis that regular smokers in past decades consumed fewer cigarettes per day than contemporary smokers.

The empirical relationships between rates of smoking cessation (Table 2), changes in F.T.C. "tar" and nicotine delivery of cigarettes (Table 3), and increases in daily cigarette consumption (Table 4) are poorly understood (25). It is not known whether smokers of the lowest "tar" cigarettes are more or less likely to attempt to quit, or to succeed in quitting, than smokers of conventional filtertip or nonfilter cigarettes. The extent to which the act of switching to a lower "tar" cigarette may serve as a substitute for quitting may differ among women and men. The observed increase in daily cigarette consumption among current smokers could represent the effect of: higher cessation rates among lighter smokers; an increase in the daily cigarette consumption of continuing smokers; or an increased daily cigarette consumption of new entrants into the smoking population; or a combination of these effects (24). The relationship of these possible mechanisms to the observed increase in the proportion of filtertip cigarette and low "tar" cigarette smokers is not well elucidated.

**Exposure to Cigarette Smoke Among Successive Birth Cohorts**

Figures 3 and 4 depict estimates of the prevalence of current cigarette smoking from 1900 to 1978 among successive birth cohorts of men and women. Each continuously graphed time series corresponds to individuals born during a particular decade. For example, among women born from 1931 to 1940 (Figure 4), who are now 40 to 49 years old, the prevalence of smoking rose rapidly during the post World War II period and reached a peak of 45 percent by 1963. Thereafter, their overall prevalence of smoking declined to 39 percent in 1978.

These prevalence data were constructed from the reported lifetime smoking histories of over 13,000 respondents to the Health Interview Survey during July to December, 1978. (For related applications of this methodology, see 7,15,27). Although the accuracy of survey recollection of age started smoking, age of smoking cessation, and the duration of significant, temporary periods of abstinence is not known, no particular source of recall bias has been identified (15,16). However, the significantly higher mortality rates of continuing smokers, as compared to

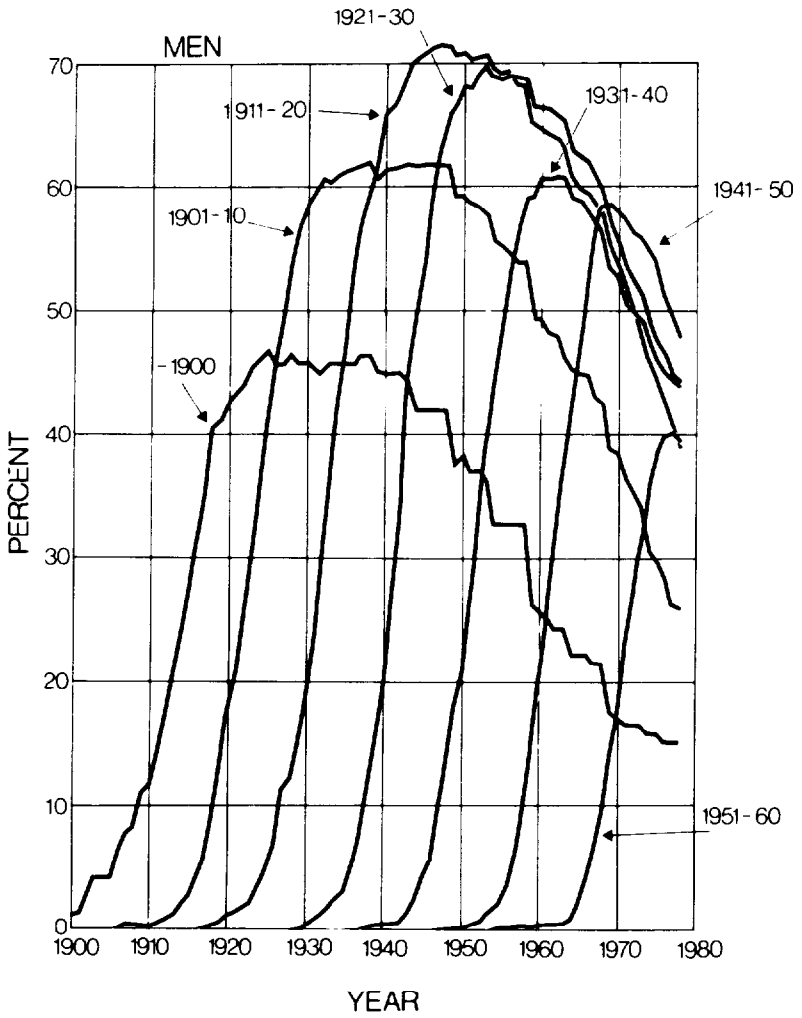


**FIGURE 3.—Changes in the prevalence of cigarette smoking among successive birth cohorts of men, 1900–1978**

Calculated from the results of over 13,000 interviews conducted during the last two quarters of 1978, provided by Division of Health Interview Statistics, U.S. National Center for Health Statistics.

SOURCE: U.S. Department of Health, Education, and Welfare (60).

nonsmokers or former smokers (1,11,17,18,41,45,46,52), introduces a selection bias that may understate the prevalence of past smoking for the oldest cohorts. For example, on the basis of the insurance life tables recently reported by Cowell and Hirst (11), a male cigarette smoker at age 32 has an estimated 25 percent probability of surviving to age 80, as compared to 49

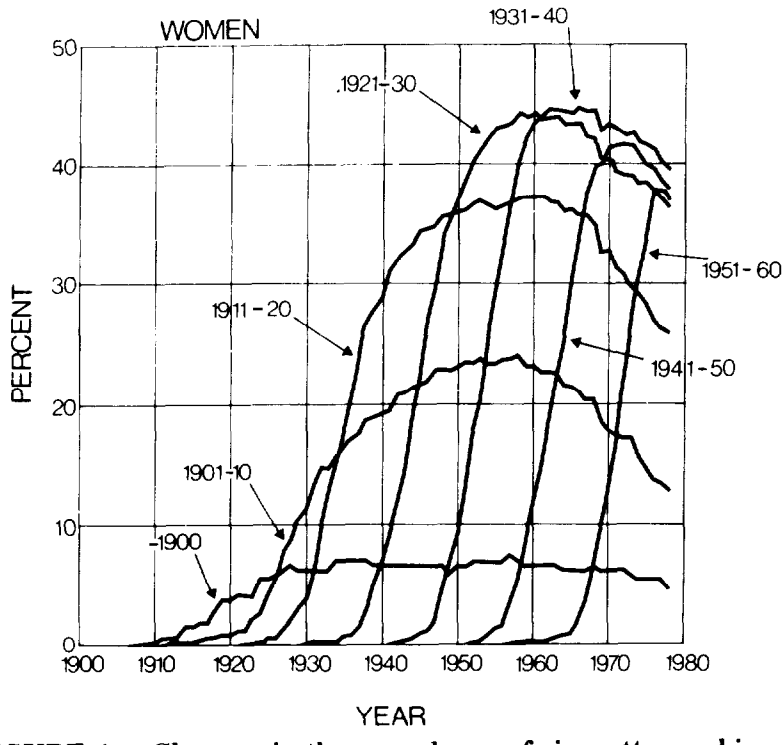


**FIGURE 4.—Changes in the prevalence of cigarette smoking among successive birth cohorts of women, 1900–1978**

Calculated from the results of over 13,000 interviews conducted during the last two quarters of 1978, provided by Division of Health Interview Statistics, U.S. National Center for Health Statistics.
SOURCE: U.S. Department of Health, Education, and Welfare (60).

percent for a nonsmoker. The estimated probabilities of surviving to age 60 are 80 percent for smokers and 93 percent for nonsmokers, respectively. Therefore, the peak smoking prevalence rate of men born before 1900, calculated from 1978 survey responses to be 46 percent in 1937, could actually have been as high as 65 percent. Since individuals who quit smoking have a higher survival than continuing smokers (18,45), the actual point in time at which smoking rates peaked in this cohort may have been later than 1937. This effect is less likely to be important among men born after 1910, who are now approaching 70 years old. A similar calculation for men born, for example, between 1911 and 1920 reveals that their peak smoking rate may have been understated by at most 2 or 3 percentage points.

This source of bias is likely to be less important for older women. On the basis of age-specific mortality data reported by

Hammond in 1966 (18, Appendix Table 2b), women continuing to smoke cigarettes from age 35 would have an estimated 48 percent chance of surviving to age 80 years, as compared to 54 percent for nonsmokers. The estimated probabilities of survival to age 60 would be 91 percent for smokers and 93 percent for nonsmokers. If these survival data are currently applicable to women smokers and nonsmokers, then the estimated peak prevalence rate of smoking among women born before 1910 could be understated by only one to two percentage points.

Despite these possible biases, the predicted percentages of current smokers in Figures 3 and 4 are consistent with past survey and epidemiological data on the smoking habits of different age groups (12,14–16,19–23,30,35,36,55).

Comparison of Figures 3 and 4 reveals the following conclusions. (a) The most marked differences in smoking prevalence among men and women appeared in those individuals born before 1910, who are now over 70 years of age. (b) Women born between 1921 and 1940, who are now approaching 40 to 59 years of age, experienced the highest smoking prevalence rates. These women have not yet reached the age where the absolute excess deaths of smokers over nonsmokers are expected to become substantial (1). (c) Among successive cohorts of men and women, the age of peak smoking prevalence has declined. Among younger cohorts, the peak smoking prevalence rates are declining, although the effect is less marked for women. Men born between 1911 and 1920 reached a peak smoking prevalence of 71 percent during 1946 to 1948, while those born 1941 to 1950 reached a peak smoking prevalence of 58 percent in 1968 to 1969. Women born 1921 to 1930 reached a peak prevalence of 44 percent in 1958 to 1960, while those born in 1941 to 1950 reached a peak smoking prevalence of 41 percent in 1970 to 1973. (d) Among men born 1951 to 1960, the rate of increase of smoking prevalence was slower than in previous cohorts. This slowing of the diffusion of smoking practices was coincident with the increased publicity concerning the health risks of smoking and the relatively high rate of quitting smoking among adult males in the late 1960s. A similar effect is not clearly discernible for young women in this cohort. In both sexes, among individuals who are now approaching ages 20 to 29, the prevalence of smoking has apparently peaked. Smoking rates among men and women in this age group are now nearly indistinguishable.

Figure 5 depicts the mean age of starting regular smoking among successive birth cohorts, calculated from the same data as for Figures 3 and 4. The age of onset of smoking among women declined continuously during this century, to the point where it is nearly indistinguishable from that of men. As a re-

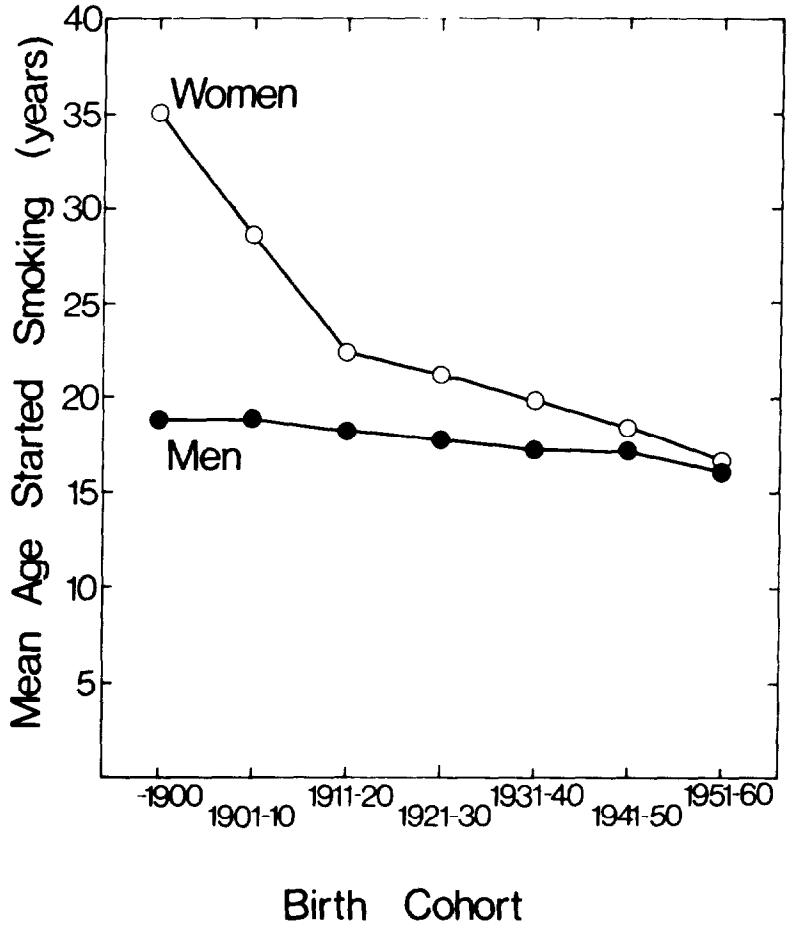


**FIGURE 5.—Mean age of onset of regular smoking among successive birth cohorts of women and men**

SOURCE: U.S. Department of Health, Education, and Welfare (60).

sult, each successive cohort of lifelong continuing women smokers will have an increasing number of years of exposure to cigarette smoke.

Figure 6 depicts the accumulated years of cigarette smoking per capita, up to 1978, for each birth cohort. These magnitudes correspond to the total areas under each cohort prevalence curve in Figures 3 and 4. Among women, individuals born 1911 to 1920 have thus far experienced the largest total exposure per capita. However, as seen from Figure 4, unless the smoking prevalence rates of women born during 1921 to 1940 decline more rapidly in the future, the lifetime exposure of these latter cohorts is likely to exceed that of the 1911 to 1920 cohort. It is not clear, however, whether the lifetime exposure of men born

from 1921 to 1940, now 50 to 69 years of age, will exceed that of previous generations. With each successive cohort, the ratio of female to male exposure increasingly approaches one.

As a result of the rapid diffusion of filtertip cigarettes after 1950 (Figure 1), each successive birth cohort was exposed to a different proportion of filtertip and nonfilter cigarettes. Details of the respondent's past history of cigarette brand use were not obtained in the 1978 Health Interview Survey. Such data, however, are available from a series of over 2,000 interviews of current and former smokers aged 21 years and over, conducted by the National Clearinghouse for Smoking and Health in 1975 (62). Figure 7 depicts, for the same birth cohorts, the proportion of lifetime years of smoking that represents filtertip cigarette use. (The birth dates of the youngest cohorts in Figures 6 and 7 do not match due to differences in survey date and eligible age group.) Among men, there is a distinct, monotonically increasing relation between the proportion of filtertip cigarette exposure and birth date. The corresponding relationship among women born before 1930 reflects their lower smoking cessation rates and, therefore, their continued use of filter cigarettes (62). A woman born in 1925, for example, who began smoking at age 21 (Figure 5), and who switched to filtertip cigarettes in 1957 (Figure 1), has now been smoking filtertip cigarettes for over two thirds of her smoking career and 40 percent of her entire life.

The prevalence of cigarette smoking, age of initiation, lifetime duration of smoking, and the extent of use of various types of cigarettes are not the only measures of cigarette smoke exposure among a particular population. Trends in depth of inhalation, fraction of cigarette actually smoked, and other dimensions of the style of smoking also affect smoke exposure. However, as discussed in the 1979 Surgeon General's Report (24), these are difficult to determine from survey data. In view of the concern over the accuracy of contemporaneous survey reports of daily cigarette consumption (65); past accounts of the time course of daily cigarette consumption would be difficult to assess accurately. Nevertheless, the evidence presented in the previous section is consistent with the conclusion that the average daily cigarette consumption among regular cigarette users has increased among each successive birth cohort.

### Cigarette Smoking Among Young Women

The more marked decline in peak smoking prevalence among men born between 1951 and 1960, now approaching 20 to 29 years of age, reflected a slowing in the rate of initiation of smok-

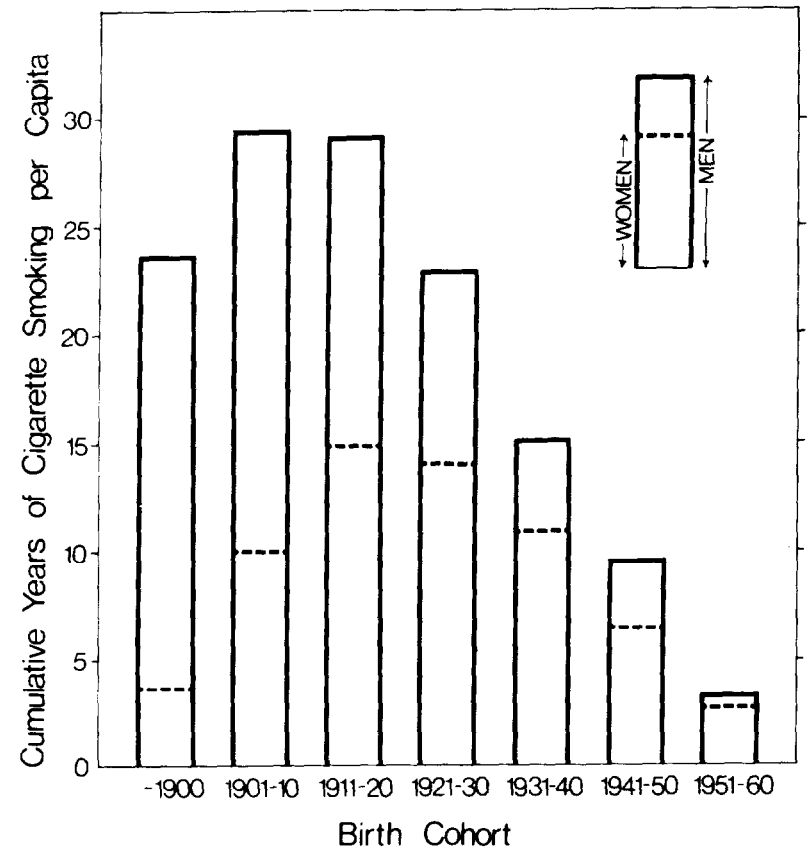


**FIGURE 6.—Accumulated years of cigarette smoking per person among successive birth cohorts of women and men, 1978**

SOURCE: U.S. Department of Health, Education, and Welfare (60).

ing that was not observed in women of the same age group. This trend appears to be continuing in the next birth cohort.

Table 5 reports the results of nation-wide surveys of teenage cigarette smoking during 1968 to 1979. The most recent survey, conducted by the National Institute of Education during late 1978 and early 1979, presents the preliminary results of over 2,600 telephone interviews of individuals aged 12 to 18 years. In this survey, but not in the others reported in Table 5, women and men 19 years of age were also interviewed. Otherwise, the survey sampling techniques and interview questions regarding smoking practices were the same for all the surveys. (See notes to Table 5).

The data in Table 5 support the conclusion that the rate of initiation of smoking among even the youngest men is declining,

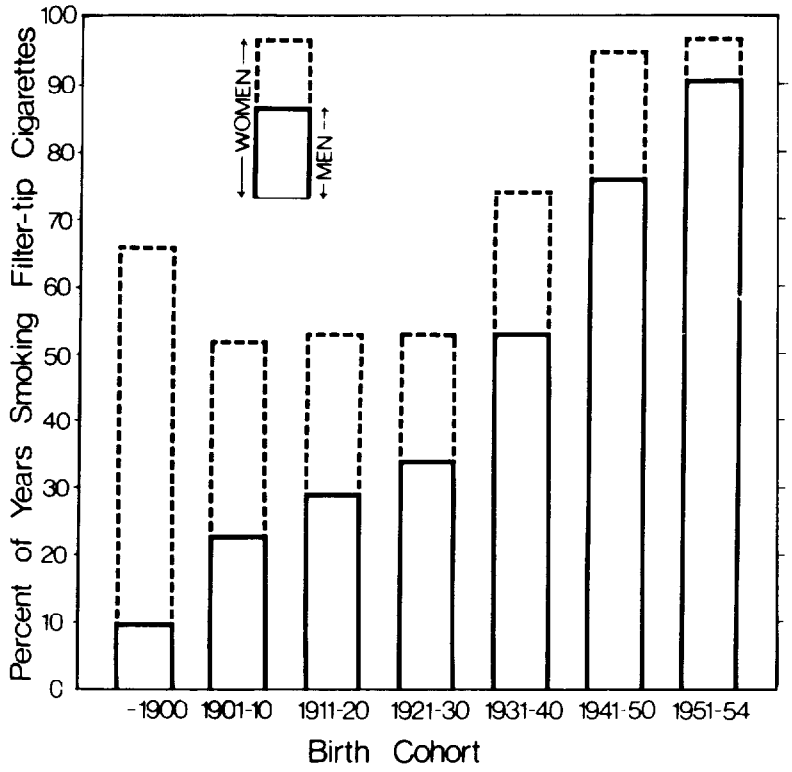


**FIGURE 7.—Proportion of years smoking filtertip cigarettes among successive birth cohorts of women and men, 1975**

Calculated from the results of over 2,000 smoking histories of men and women who had ever smoked, collected by National Clearinghouse for Smoking and Health.
SOURCE: U.S. Department of Health, Education, and Welfare (62).

an effect that is not present among young women. These results must be interpreted in light of sampling variability. (The absolute standard errors on the 1979 estimates for ages 15–16 and 17–18 are about 2 percent.) As in adult surveys, non-response biases must also be considered. Nevertheless, the findings in Table 5 are consistent with other nation-wide estimates of smoking rates among young women and men. The prevalence of current regular smoking among respondents 17 to 19 years of age in this survey was 28.1 percent for females and 22.8 percent for males. The comparable rates for women and men aged 17 to 19 from the Health Interview Survey were 29.2 percent and 27.5 percent, respectively. An analysis of the growth of smoking prevalence among this group, performed in the same manner as

TABLE 5.—Estimated percentage of current, regular cigarette smokers, ages 12–18, United States, 1968–1979

| Year | Ages 12–14 | Ages 15–16 | Ages 17–18 |
|---|---|---|---|
| Females | | | |
| 1968 | 0.6 | 9.6 | 18.6 |
| 1970 | 3.0 | 14.4 | 22.8 |
| 1972 | 2.8 | 16.3 | 25.3 |
| 1974 | 4.9 | 20.2 | 25.9 |
| 1979 | 4.4 | 11.8 | 26.2 |
| Males | | | |
| 1968 | 2.9 | 17.0 | 30.2 |
| 1970 | 5.7 | 19.5 | 37.3 |
| 1972 | 4.6 | 17.8 | 30.2 |
| 1974 | 4.2 | 18.1 | 31.0 |
| 1979 | 3.2 | 13.5 | 19.3 |

Nation-wide surveys performed by National Clearinghouse for Smoking and Health, 1968–1974, and National Institute of Education, 1979. Current regular smokers in all surveys include all those who smoke cigarettes at least weekly. In 1979, approximately 90 percent of current regular smokers used cigarettes on a daily basis. For 1979 only, 29.7 percent males and 31.9 percent females, aged 19, were reported as regular smokers.

SOURCE: U.S. Department of Health, Education, and Welfare (63).

that of Figures 3 and 4, suggested that smoking rates among this group of women grew rapidly and exceeded those of men by 1975. The future smoking habits of this generation of young women cannot be accurately predicted.

Smoking among adolescent women is discussed in greater detail in the chapter entitled "Psychosocial and Behavioral Aspects of Smoking in Women" in this Report.

## Summary

1. Women have differed from men in their historical onset of widespread cigarette use, in the rate of diffusion of smoking among each new birth cohort, in their intensity of cigarette smoking and their use of various types of cigarettes.

2. Men took up cigarette smoking rapidly at the beginning of the twentieth century, especially during World War I. Cigarettes rapidly replaced other forms of tobacco. By 1925, approximately 50 percent of adult males were cigarette smokers. Smoking among men accelerated rapidly during World War II. By 1950, the prevalence of cigarette use among men approached 70 percent in some urban areas.

3. The onset of widespread cigarette use among women lagged behind that of men by 25 to 30 years. The proportion of adult

women smoking cigarettes did not exceed one-quarter until the onset of World War II.

4. Between 1951 and 1963, increasing proportions of women and men smokers converted to filtertip cigarettes. By 1964, 79 percent of adult women smokers and 54 percent of adult men smokers used filter cigarettes.

5. After reaching a peak value of 4,336 in 1963, annual per capita consumption of cigarettes declined in 1964, 1968–70, and in the period since 1975. The most recent estimate of 3,900 cigarettes per capita in 1979 is approximately equal to that observed in 1952.

6. From 1965 to 1978, the proportion of adult men cigarette smokers declined from 51 to 37 percent. The preliminary estimate of adult men's smoking prevalence for 1979 is 36.9 percent. From 1965 to 1976, the proportion of adult women smokers remained virtually unchanged at 32 to 33 percent. Since 1976, the proportion of women smokers has declined to below 30 percent. For 1979, the preliminary estimate of adult women's smoking prevalence is 28.2 percent. The overall smoking prevalence of 32.3 percent for both sexes in 1979 represents the lowest recorded value in at least 45 years.

7. The proportion of adult smokers attempting to quit smoking declined from 1970 to 1975, but increased in 1978–1979. In contrast to past years, the proportions of women and men now attempting to quit smoking, and their reported quitting rates, are indistinguishable. Approximately one in three adult smokers now makes a serious attempt to quit smoking during the course of a year. Approximately one in five of those who attempt to quit subsequently succeed.

8. The proportion of adult smokers using lower "tar" and nicotine brands has increased substantially. In 1979, 39 percent of adult women smokers and 28 percent of adult men smokers reported primary brands with F.T.C. "tar" delivery less than 15.0 milligrams. It is not known whether smokers of the lowest "tar" cigarettes are more or less likely to attempt to quit smoking, or to succeed in quitting, than smokers of conventional filtertip or non-filter cigarettes.

9. The average number of cigarettes smoked by women and men current smokers has increased. The relationship of this finding to recent declines in the average F.T.C. "tar" and nicotine deliveries of cigarettes is not well understood.

10. With each successive generation, the smoking characteristics of women and men have become increasingly similar.

11. Among women, the average age of onset of regular smoking progressively declined with each successive birth cohort—from 35 years of age for those born before 1900, to 16 years of

age among those born 1951 to 1960. The average age of onset of regular smoking among young women is now virtually identical to that of young men.

12. Maximum smoking prevalence rates have declined substantially in recent birth cohorts of men. Men born 1931 to 1940 reached a peak smoking proportion of 61 percent during 1960–62, while men born 1941 to 1950 reached a peak smoking proportion of 58 percent in 1968–69. Men born 1951 to 1960 reached a peak smoking proportion of 40 percent in 1976. Among recent cohorts of women, peak smoking prevalence rates have declined to a much smaller extent. Women born 1931 to 1940 reached a peak smoking proportion of 45 percent in 1966–68, while women born 1941 to 1950 reached a peak smoking proportion of 41 percent in 1970–73. Women born 1951 to 1960 reached a peak smoking proportion of 38 percent in 1976. Among the generation born 1951 to 1960, the proportions of women and men smoking cigarettes are now virtually identical.

13. The proportions of women and men smokers in each age group have declined. Among those born before 1951, this decline in smoking prevalence resulted mainly from smoking cessation. By contrast, the observed decline in smoking prevalence among younger men born 1951 to 1960 has resulted from both smoking cessation and a lower rate of smoking initiation. This decline in the rate of onset of smoking among young men has not been observed for young women.

14. Recent survey data on adolescent smoking habits reveal that by ages 17 to 19, smoking prevalence among women exceeds that of men. This finding supports the conclusion that the rate of initiation of smoking among young men—but not that of young women—is declining. The future cigarette use of the youngest generations of women is uncertain.

15. With each successive birth cohort, the accumulated years of cigarette smoking per woman has progressively approached the accumulated years of cigarette smoking per man. Each successive birth cohort has also experienced progressively smaller sex differences in the fraction of lifetime years of smoking that represents filtertip cigarette use.

16. Among men born during this century, each successive birth cohort has thus far experienced fewer cumulative years of cigarette smoking, higher proportionate exposure to filtertip cigarettes, and lower smoking prevalence rates. This relationship between birth date and cigarette smoke exposure does not hold for women. Women born 1921 to 1940 have experienced substantially higher smoking prevalence rates than earlier generations. Unless they quit smoking in substantial numbers, these women, currently aged 40 to 59, will surpass older women

in total years of cigarette smoking per capita, the total years of nonfilter cigarette smoking per capita, and in the total number of cigarettes smoked. The health consequences of this enhanced exposure to cigarette smoke among women are likely to be more prominent in the coming decades.

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# PART II:

# BIOMEDICAL ASPECTS OF SMOKING.

# MORTALITY.

## MORTALITY

### Introduction and Background

Cigarette smoking has been cited as the single most important environmental factor contributing to premature mortality in the United States (17). A great many epidemiological studies support this statement. The emphasis, in general, has been to study males rather than females. Perhaps the main reason for this discrepancy is that, in the past, relatively few women smoked whereas smoking was common among men. The upward trend in lung cancer death rates in males observed in the 1950s by Dorn and others stimulated epidemiologic studies of smoking and health, especially among males (2,3).

According to the 1979 Surgeon General's Report:

> It is important that attention be called specifically to the mortality that females experience as a result of cigarette smoking. There has been an increase in smoking among teenage girls over the past 10 years. At present, the percentages of teenage boys smoking and teenage girls smoking are nearly identical. For some ages, there are more teenage girl smokers than boy smokers. Over the past 10 years, there has been a gradual reduction in the percentage of the adult population that is smoking. Men have quit in greater numbers than women. There has been only a modest drop in the percentage of women who are smoking. In Canada and several European countries, smoking is decreasing among men but increasing among women.

The present report reviews some of the more important prospective epidemiological studies on cigarette smoking and mortality among women.

### Mortality Trends

As background, this section reviews mortality levels by sex and color in the United States, by examining recent trends in overall mortality and in three causes of death which have been strongly linked to cigarette smoking—ischemic heart disease, lung cancer and the combined category of bronchitis, emphysema and asthma.*. These trends are displayed in Figures 1 through 4.

For all causes of death (Figure 1), the trend for females was downwards over the entire period from 1950 to 1977 with a somewhat steeper decline in recent years. The trend in death rates among males was essentially flat during most of the 1950s and 1960s, but has been sharply downwards since the late 1960s.

*The category, chronic obstructive lung disease, may include asthma, a disease which is not causally related to smoking.

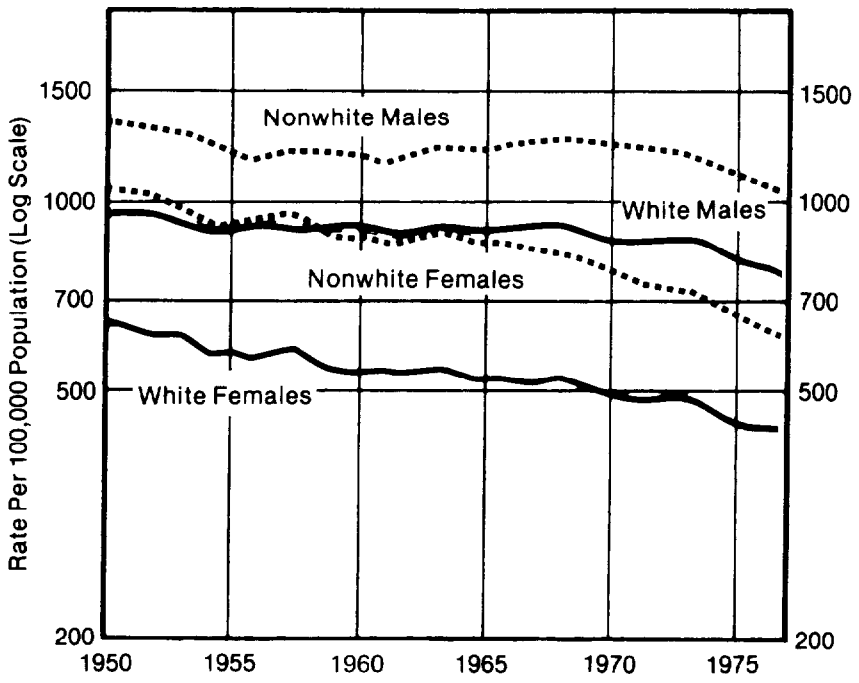


**FIGURE 1.—Age-adjusted death rates* for all causes of death by color and sex; United States, 1950–1977**

*Adjusted by the direct method to the U.S. population, 1940.
SOURCE: National Center for Health Statistics (9).

For ischemic heart disease, the death rate trend for all sex and color groups was upwards until it flattened in the 1960s. It has been sharply downward since then (Figure 2).

For lung cancer the trend was sharply upwards during the entire period, especially for females (Figure 3).

For bronchitis, emphysema and asthma, the death rate has been sharply upwards for all sex and color groups except nonwhite females. In recent years there appears to be a leveling off for males but not for white females (Figure 4). Other investigators have studied these trends, especially in relation to changes in cigarette smoking habits in the United States and their potential effect upon mortality from the smoking-related diseases (8,12). There are inherent difficulties in interpreting trend data and in particular in relating one trend to another.

## Epidemiological Studies

During the past 30 years, there have been eight large pro-

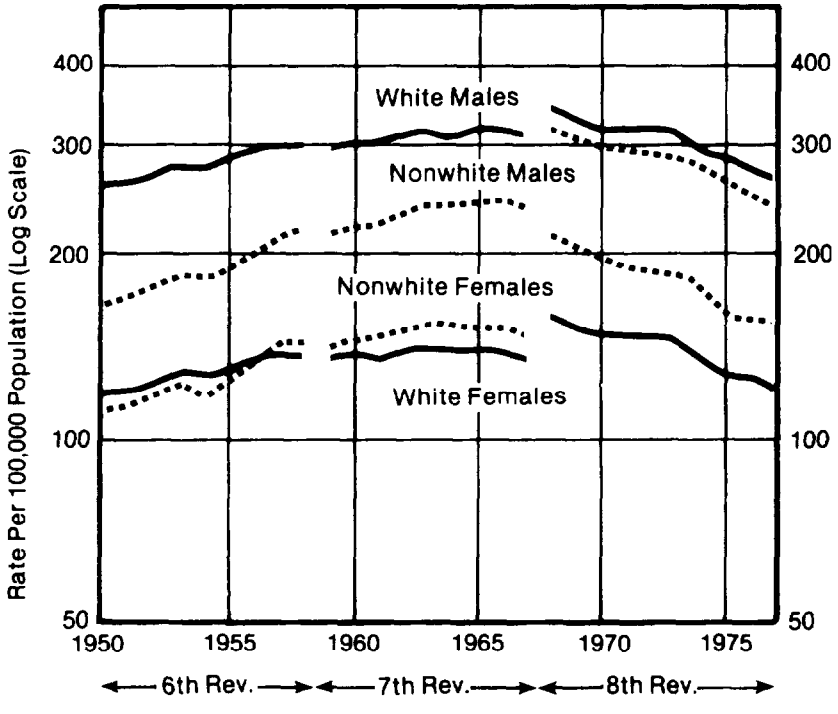


**FIGURE 2.—Age-adjusted death rates* for ischemic heart disease** by color and sex, United States, 1950–1977**

*Adjusted by the direct method to the U.S. population, 1940.
**ICD 6th and 7th Rev. No. 420 and 8th Rev. Nos. 410, 413.
SOURCE: National Center for Health Statistics (9).

spective epidemiological studies specifically designed to delineate the relationship between tobacco smoking and the development of disease. In five of these studies data are available on women as well as men. These studies are outlined below and in Table 1 (1,2,4,5,7,10). To these published results are added unpublished data from two other studies conducted by the National Heart, Lung, and Blood Institute, and from the British Doctors Study.

## THE AMERICAN CANCER SOCIETY 25-STATE STUDY (6)

The largest study by far is the American Cancer Society study of men and women in 25 states. In late 1959 and early 1960, the American Cancer Society enrolled 1,078,894 men and women in a prospective study. All segments of the population were

**TABLE 1.—Outline of prospective studies of smoking and mortality among women**

| Authors | Hammond (5) | Cederlof Friberg Hrubec Lorich (1) | Best Josie Walker (4) | Hirayama (7) | Doll Gray Peto (2) | Framingham Heart Study (10) | British-Norwegian Migrant Study British Norwegian (10) | |
|---|---|---|---|---|---|---|---|---|
| Type of subjects | Volunteers in 25 states | Probability sample of the Swedish population | Canadian pensioners & dependents | Total pop. of 29 health districts in Japan | British doctors | Sample plus volunteers from Framingham, Mass. (whites) | Probability sample of British & Norwegian migrants to U.S. in 12 states | |
| Number of female subjects | 562,671 | 27,732 | 14,226 | 142,857 | 6,192 | 2,873 | 9,057 | 5,337 |
| Age range at baseline | 35–84 | 18–69 | <30 to 80 + | 40 + | 25 to 75 + | 29–62 | 45–74 | 45–74 |
| Year of enrollment | 1959 | 1963 | 1955 | 1966 | 1951 | 1948 | 1962 | 1962 |
| Years of follow-up reported | 4 | 10 | 6 | 5 | 22 | 26 | 5 | 5 |
| Number of female deaths | 16,773 | 1,955 | 1,794 | 1,508 | 1,090 | 662 | 588 | 354 |
| Basic statistical measure | Person-yrs. death rate | Probability of death in 10 yrs. | Probability of death in 6 yrs. | Person-yrs. death rate | Person-yrs. death rate | Probability of death in 26 yrs. | Probability of death in in 5 years | |

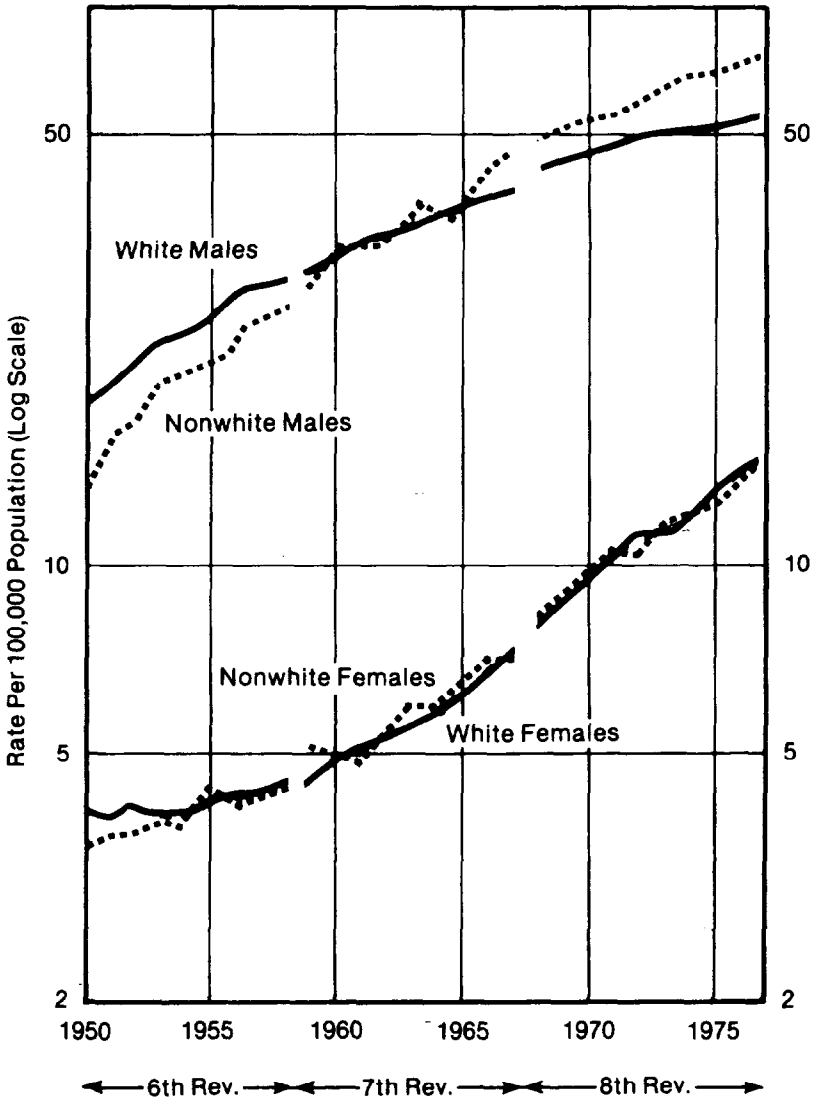


**FIGURE 3.—Age-adjusted death rates* for malignant neoplasm of trachea, bronchus, and lung,** by color and sex, United States, 1950–1977**

*Adjusted by the direct method to the U.S. population, 1940.
**ICD 6th and 7th Rev. Nos. 162, 163 and 8th Rev. No. 162.
SOURCE: *National Center for Health Statistics* (9).

included except groups that could not be traced easily. A lengthy initial questionnaire contained information on age, sex, race,

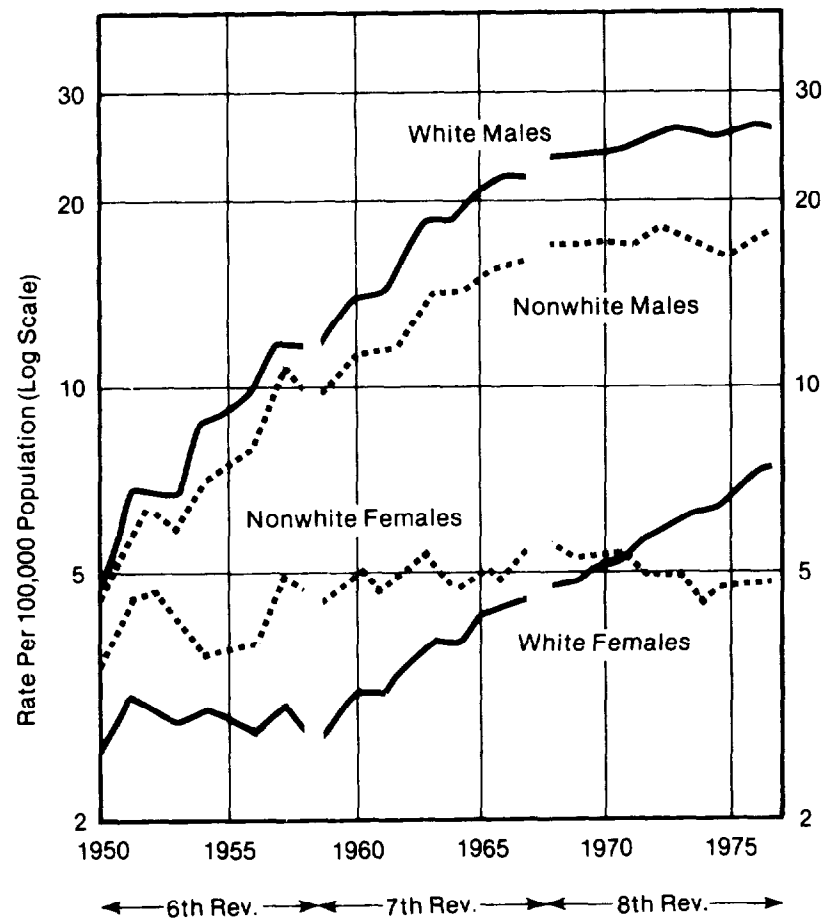


**FIGURE 4.—Age-adjusted death rates* for bronchitis, emphysema, and asthma** by color and sex, United States, 1950–1977**

*Adjusted by the direct method to the U.S. population, 1940.
**ICD 6th and 7th Rev. Nos. 241,501,502,527.1 and 8th Rev. Nos. 490,493,549.3.
SOURCE: National Center for Health Statistics (9).

education, place of residence, family history, past diseases, present physical complaints, occupational exposures, and various habits. Information on smoking included: type of tobacco used, number of cigarettes smoked per day, degree of inhalation, age at which smoking began, and the brand of cigarettes used from which the "tar" and nicotine content of the cigarette could be calculated. Nearly 93 percent of the survivors were successfully followed for a 12-year period. Only limited data